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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/584,053	06/22/2006	Frederic Mazen	292759US0PCT	4625
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OBLON, SPIVAK, MCCLELLAND MAIER & NEUSTADT, P.C. 1940 DUKE STREET ALEXANDRIA, VA 22314				
EXAMINER				
MILLER, JR, JOSEPH ALBERT				
ART UNIT		PAPER NUMBER		
1792				
NOTIFICATION DATE		DELIVERY MODE		
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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### Office Action Summary

**Application No.**

10/584,053

**Applicant(s)**

MAZEN ET AL.

**Examiner**

JOSEPH MILLER JR

**Art Unit**

1792

**Period for Reply** -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 28 April 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1,3,4,7,11,13-15 and 26-34 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,3,4,7,11,13-15 and 26-34 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/808)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Priority Observation***

It appears that the French language document, Application No. FR 0651186, does not provide support for material in claims 1 or 31, wherein the focused beam comprises germanium ions. The support for this in the instant application ([0021] and [0034]) is present, but missing in the priority application.

### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claim 29 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The claim requires a metal substrate, however, the specification does not support the use of a "metal" substrate. In [0021] and [0047], it teaches the use of insulators and metal oxides.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 3, 4, 7, 11, 13-15, 26, 30 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mazen (Applied Surf. Sci.) in view of Sato (5,363,793).

Mazen teaches a two step method of growing silicon nano-crystals (title, abstract). Mazen teaches the formation of nucleation sites followed by the CVD of silicon crystal dots (abstract).

Mazen does not teach formation of the nucleation sites by localized deposition by means of a focused beam comprising silicon or germanium.

Sato teaches a method for growing single crystal material (abstract). Sato teaches that it is known to provide nucleation sites for the formation of Si-single crystals by depositing Si ions using a focused ion beam (col 5, lines 15-25).

It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the method taught by Sato of using a FIB to deposit Si nucleation sites with the method of Mazen as the use of a FIB would allow for production of "a plurality of nucleation surfaces arranged at desired positions on the substrate" (col 5, lines 12-15). (Though the statement is made in regards to nucleation sites formed of amorphous silicon nitride, it is clear from the context of the paragraph that the teaching is similarly true for the use of the ion beam implanted Si sites).

One could then apply the method of CVD Mazen to effectively form the "nano-crystals" based on the fact that the crystals of Mazen are "mono-crystalline" (abstract), and the CVD method of Mazen would reasonably be expected to effectively produce nano-crystals from the nucleation sites of Sato (who also formed single crystal Si).

Regarding claims 3, 4 and 26, Mazen teaches an SiO<sub>2</sub> substrate (abstract).

Regarding claim 7, Mazen teaches the growth of Si structures using  $\text{SiH}_2\text{Cl}_2$  as a gaseous precursor (last sentence of section 1, p360).

Regarding claims 11 and 32, Sato teaches that GaAs and Si have similar properties for semiconductors (col 1, lines 31-44), therefore, It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the method taught to form GaAs nanostructures for electronic devices.

Regarding claim 13, Mazen teaches dots which are three-dimensional shapes (see Fig. 2; abstract); it is inherent that since the dots have a diameter, they have a depth (i.e. into the paper per Fig. 2).

Regarding claim 14, Mazen teaches the growth of structures less than 10 nm (p361, 2nd column).

Regarding claim 15, Mazen teaches a density of nanostructures are produced in the  $10^{10}$  to the  $10^{12}$  / $\text{cm}^2$  range (pg 359, 2<sup>nd</sup> col), thereby teaching upon claimed range.

Regarding claim 26, Mazen teaches the use of an  $\text{SiO}_2$  substrate (p360, experimental, first sentence).

Regarding claim 30, the beam taught by Sato is of Si ions.

Claims 11 and 32-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mazen (Applied Surf. Sci.) in view of Sato (5,363,793) as applied to claim 1 above and in further view of Islam (2005/0133476).

The teachings of Mazen in view of Sato are described. They teach the formation of silicon nanostructures but not structures comprising GaAs, GaN or GaP.

Islam teaches a method of forming nanowires (abstract). The nanowires may comprise Si, Ge, GaAs, GaN, or GaP [00033]. Islam teaches that a gas would be applied appropriate to grow the desired nanowire [0068-0072].

It would have been obvious to someone of ordinary skill in the art at the time of the invention to grow nanostructures comprising GaN, GaP, or GaAs as taught by Islam to the 2 step nanostructure growth method of Mazen as one would apply the use of a gas appropriate to grow such nanostructures with a reasonable expectation of growing such nanostructures. The nanowires of Islam are analogous/synonymous with the nanostructures of Mazen.

Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mazen (Applied Surf. Sci.) in view of Sato (5,363,793) as applied to claim 4 above and in further view of Baron (Microelectronic Engineering, 2002).

The teachings of Mazen in view of Sato are described. They teach the formation of nanostructures by CVD after forming nucleation sites by FIB, but do not teach the use of a silicon nitride substrate.

Baron teaches a method of controlling the nucleation of CVD growth silicon nanocrystals (title). Baron teaches that silicon nitride was tested as a substrate (p515).

It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the use of a silicon nitride substrate as taught by Baron to the

nanostructure growth process of Mazen in view of Sato. Though Baron teaches that SiO<sub>2</sub> is preferable over silicon nitride, the concept of the alternative substrate is introduced and apparently a viable if not preferable alternative.

Claims 27 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mazen (Applied Surf. Sci.) in view of Sato (5,363,793) as applied to claims 4 and 1 above and in further view of Empedocies (2004/01129644).

The teachings of Mazen in view of Sato are described. They teach the formation of nanostructures by CVD after forming nucleation sites by FIB, but do not teach the use of an aluminum oxide or metal substrate.

Empedocies teaches the use of a substrate coated with aluminum oxide followed by formation of silicon nanowires on top of the aluminum oxide [0181].

It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the use of an aluminum oxide substrate as taught by Empedocies to the silicon nanostructure formation method of Mazen in view of Sato as it would provide one potential use in manufacture of a device with the nanostructures formed.

Since the aluminum oxide is the formation upon which the silicon nanowires are formed, it could be, in broad terms, considered the substrate.

Alternatively, in regards to claim 29, the metal layer could be considered the substrate, with the aluminum oxide layer deposited on the substrate prior to the silicon nanowires.



Claim 31 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mazen (Applied Surf. Sci.) in view of Sato (5,363,793) as applied to claim 1 above and in further view of Mizumura (5,504,340).

The teachings of Mazen in view of Sato are described above, teaching the use of a FIB to deposit ions for nucleation sites from which nanostructures may be grown. They do not, however, teach the use of a FIB of germanium ions.

Mizumura teaches that when using a silicon substrate, it is preferable to use a FIB of Si or Ge in order not to introduce any impurities onto the substrate (col 4, lines 12-44).

It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the use of germanium ions as taught by Mizumura as an alternative to the Si ions in the process of Mazen in view of Sato as one could apply Ge ions as an effective alternative to Si ions without instituting additional impurities into a device (col 7, lines 14-25). The purpose of the formation of Mazen's nanocrystals is in the formation of devices (introduction, col 1, p359). While Mazen teaches the use of Si, Sato teaches that Si and Ge have similarly properties as applied

In alternative, claim 31 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mazen (Applied Surf. Sci.) in view of Sato (5,363,793) as applied to claim 1 above and in further view of Mizumura (5,504,340) and Islam (2005/0133476).

The arguments as applied above are held as valid, however, an additional motivation for the use of Ge is being introduced.

One may be particularly interested in using Ge ions for the formation of Ge nanowires; Islam teaches that semiconductor nanowires may comprise Si or Ge (among others).

It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the use of Ge ions for the formation of nucleation sites as taught by Mazen in view of Sato and Mizumura in order to produce Ge nanowires of Islam because, though the growth of nanowires does not require the same nucleation material, the desire for purity is well known in the semiconductor industry and therefore it would be obvious to apply the Ge beam of Mizumura when forming Ge nanowires as taught by Islam.

Claims 32-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mazen (Applied Surf. Sci.) in view of Sato (5,363,793) as applied to claim 11 above and in further view of Lieber (2002/0117659).

The teachings of Mazen in view of Sato are described. They teach the formation of silicon nanostructures but not structures comprising GaAs, GaN or GaP.

Lieber teaches a method of manufacture of nanowires (abstract). Lieber teaches that nanowires may comprise GaAs, GaN or GaP [0086, 0093-0103], claim 84.

It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the method of Mazen in view of Sato to form nanostructures of GaAs, GaN or GaP based on Lieber's teaching that nanostructures of these materials

may be effectively grown. Sato suggests the use of "Si, Ge, GaAs etc" (col 1, lines 35-37) materials as semiconductor materials.

### ***Response to Arguments***

Applicant's arguments with respect to previous claims have been considered but are moot in view of the new ground(s) of rejection. Applicant has overcome previous rejections over the prior art applied due to amendment.

### ***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOSEPH MILLER JR whose telephone number is (571) 270-5825. The examiner can normally be reached Mon - Thurs, 7am to 6pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks, can be reached on 571-272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/JOSEPH MILLER JR/  
Examiner, Art Unit 1792

/Timothy H Meeks/  
Supervisory Patent Examiner, Art Unit 1792